Station Briefing Papers

Science-Based Solutions for the Four Threats to the Health of the Nation's Forests and Grasslands

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FIRE AND FUELS

Current Emphasis

- ✓ Developing and testing a package of data and software called LANDFIRE to provide high-resolution data for furl treatment planning.
- ✓ Evaluating the effectiveness of rehabilitation treatments (i.e., contour felling, straw mulch, trenches, hydromulching, and other practices).
- ✓ Studying how fires affect sediment movement, downstream water quality and threatened and endangered fish species.
- ✓ Investigating the effects on wildfire on stream communities.
- ✓ Assessing fire behavior, home destruction, ecological impacts, social and economic impacts, and rehabilitation efforts on large fire case studies (example: Colorado's Hayman Fire).
- ✓ Developing decision support systems (SIMPPLLE and MAGIS) that schedule fuel treatments spatially and temporally to meet multiple management objectives.
- ✓ Assessing the accuracy of satellite mapping of large fire fronts and resulting burn scars.
- ✓ Determining the genetic variation of native plant materials to improve their ability to rehabilitate and restore fire damaged and degraded sagebrush steppe and pinyon-juniper communities.
- ✓ Developing a synthesis of the scientific knowledge about fuels treatments in dry forests/wildland-urban interface areas in the western U.S.
- ✓ Determining how fire and forest management practices affect forest pathogens such as dwarf mistletoes, stem rusts, and root diseases.

- ✓ Documenting public concerns and attitudes toward the use of fire to manage vegetation and developing public communication strategies for the southwestern U.S.
- ✓ Examining the effects of fire and overgrazing on cheatgrass invasion in Great Basin shrublands and woodlands and testing restoration methods.
- ✓ Predicting runoff and erosion after fires and after mitigation treatments, estimating the utility of post-fire treatments for storm events.
- ✓ Developing new information on the effects of fires on sensitive species.
- ✓ Documenting riparian fire history along the Rio Grande.
- ✓ Gathering baseline data on the meanings that Bitterroot Valley residents place on areas proposed for fuel hazard reduction.
- ✓ Developing and testing predictions of future rural development patterns in the Bitterroot Valley to anticipate where fuels treatments would have the greatest impact in reducing risks of wildfire.
- ✓ Studying the relationships of densely stocked forests, subsequent changes in soil nutrients, and reductions in forest productivity.
- ✓ Developing GIS applications that estimate the probability of fire across a landscape and help fire managers delineate zones where lightning-caused fires can be safely allowed to burn.
- ✓ Developing guidelines for fire managers to use in interpreting and mapping historical fire regimes and how current conditions have departed from historical fire regimes.
- ✓ Developing tools to incorporate social, ecological, economic benefits and risks of wildland fuels treatment into strategic planning.
- ✓ Monitoring effects of fuels treatments on the Mexican Spotted Owl and its prey.
- ✓ Investigating the effects of fuels reduction in the Intermountain West on habitats for birds and small mammals.
- ✓ Studying the consequences of failing to reduce fuels by comparing residual forest structure following wildfire.

Research Results

- ✓ BEHAVE has been the basis for fire safety briefings on all large fires and used as a standard tool for predicting the spread and intensity of fires. Recently, the new FARSITE model combines BEHAVE with geographical information system (GIS) data to show 3-D projections of fire spread across the landscape over time.
- ✓ MODIS satellite data has been useful in near real-time for fire monitoring, emissions forecasting, and other uses.

- ✓ First Order Fire Effects Model (FOFEM) has been successful in predicting the ecological effects of prescribed burning.
- ✓ Susceptibility of structures to fires now can be assessed and reduced by making changes to the structures and its immediate surroundings.
- ✓ Negative consequences of smoke during prescribed and wildland fires can be minimized.
- ✓ Firefighters operating in the wildland urban interface require larger safety zones than previously thought.
- ✓ Instruments that are easily transportable to wildfires and prescribed burns for diagnosing smoke composition are now available.
- ✓ Forecast of annual Forest Service fire suppression expenditures can be made with accuracy..
- ✓ Effects of changing the pay system in large fires agency on costs and employee compensation can be calculated.
- ✓ Preliminary results show that charcoal created by fire produces a chemical in the roots of knapweed that acts like an herbicide, thereby reducing the negative impact of knapweed.
- ✓ Comprehensive state-of-knowledge on the effects of fire on birds is available.
- ✓ Findings of the emerging science on the role of fire in aquatic and riparian ecosystems have been synthesized and can be viewed at (www.fs.fed.us/rm/boise/teams/fisheries/fire/firehome.htm).
- ✓ A new software tool can evaluate which slopes are at greatest risk of erosion and prioritize mitigation needs (http://forest.moscowfsl.wsu.edu/fswepp).
- ✓ Prescriptions for post-fire harvest can used to maintain and protect key habitat structures used by woodpeckers.
- ✓ Effectiveness of rehabilitation treatment depends on the weather the year following the fire.
- ✓ Mitigation treatments are less effective for larger runoff events.
- ✓ Weather events constrain a ttempts to evaluate post-fire watershed treatments, the brief time that conditions require mitigation after fire, and the continuity of burn effects.
- ✓ Following the 2000 fires Bitterroot Valley residents did not trust the Forest Service to make decisions intended to protect local values.

Further Research

- ✓ Burn conditions are being evaluated onsite to determine the benefits of using duff moisture to prevent the spread of wildfire or the escape of prescribed fire.

- ✓ Continue to monitor populations and habitats of sensitive species of birds following wildfire or fuels reduction projects.
- ✓ Determine the effectiveness of watershed rehabilitation treatments commonly used for emergency-burned area rehabilitation after wildfires.
- ✓ Pursue deeper knowledge of fire behavior fundamentals to support the next generation of fire behavior prediction models.
- ✓ Quantify the impacts of fuel treatments on wildlife.
- ✓ Develop capacities in the social sciences to become effective in community development and education.
- ✓ Develop better tools that integrate management issues (e.g., fuels and endangered species) and allow managers to identify both the opportunities and conflicts for management of multiple resources.

INVASIVE SPECIES

Current Emphasis

Cheatgrass and Medusahead

- ✓ Testing control measures for cheatgrass, an invasive annual grass that dominates millions of hectares of degraded rangeland in the West.
- ✓ Evaluating control of two highly competitive annual grasses (i.e., cheatgrass and medusahead) with low rates of herbicide application or with application of carbon to increase nitrogen sequestration by soil microorganisms.

Leafy Spurge

- ✓ Documenting the potential impacts of using biological control agents (flea beetles) on a non-target native *Euphorbia* species.
- ✓ Evaluating the relative roles of the transient and persistent seed bank in influencing recovery of the native vegetation following biological control.

White Pine Blister Rust

- ✓ Investigating methods to reduce the virulence of white pine blister rust, determine how resistant trees can be bred, and encourage planting of western white pine (and other five needle pines) on suitable sites.
- ✓ Studying the effects of fire and timber management on below-ground decomposition rates to improve productivity.
- ✓ Investigating patterns of white pine regeneration after fire.

Yellow Star Thistle

- ✓ Evaluating control methods for invasive species, such as yellow starthistle, including combinations of fire and herbicides, and reseeding with native perennial grasses.

Skeletonweed

- ✓ Evaluating the environmental conditions that promote seed germination and testing potential control methods.

Smooth Brome

- ✓ Evaluating changes in nitrogen cycling with the establishment of an invasive perennial grass (*Bromus inermis*).

Other Plants

- ✓ Evaluating the fire enhanced spread of invasive species in the Black Hills riparian corridors and urban-wildland interface.
- ✓ Considering the tradeoffs between the inadvertent impact on native species of efforts to control invasive species.

Fish

- ✓ Developing better models to predict invasion by introduced brook trout and subsequent displacement of native cutthroat and bull trout.

Research Results

- ✓ Introduced species have expanded their range, but they have not invaded all available habitats and do not always displace native species. Managers can anticipate effects and prioritize conservation efforts.
- ✓ Long-term (300 years) vegetation changes in New Mexico have allowed invasive species to become established.
- ✓ Native and exotic invasive plants have spread outside of their historical home range and what is likely to be their future impacts.

Leafy Spurge

- ✓ Infestations significantly reduce species of native plant species.
- ✓ Broadleaf herbaceous species are particularly susceptible to aerially applied herbicide meant to control leafy spurge. However, most other native species can demonstrate considerable resilience following herbicide application.
- ✓ Flea beetles promise to be an effective biological control agent. Native vegetation significantly increased within two years following flea beetle release.

Knapweed

The unintended consequence of biological control of knapweeds using insects is that the deer mice populations were feeding on the insects, which led to the unacceptable level of increase in the deer mice population.

Cheatgrass

A naturally occurring fungal disease is showing success as a biological control.

Forest Insects

Insect outbreaks are predicted to intensify with global climate warming.

White Pine Blister Rust

- ✓ White pine has been nearly eliminated in much of its historic range.
- ✓ Tree species less tolerant to blister rust (and other endemic pathogens) now dominate.
- ✓ Stands damaged by blister rust are more susceptible to catastrophic fires (which destroy soil organic matter and soil-borne microorganisms, discourage regeneration, and encourage noxious weeds, soil erosion, and site productivity losses).

Fish

- ✓ Widely introduced fishes distributed are now considered primary threats to many sensitive, threatened, or endangered aquatic species.

Further Research

- ✓ Characterize the impact of natural and human disturbance processes interactions on ecosystems.
- ✓ Estimate the effects of invasive species on fire cycles.
- ✓ Develop methods for monitoring and assessing impacts of noxious weeds.
- ✓ Describe the effects of exotic species invasions on community structure, trophic interactions, and disease dynamics.
- ✓ Develop a better understanding of the effect of microbial organisms on the environment.
- ✓ Quantify the effects of fire, insects, and disease on long-term productivity and carbon dynamics of ecosystems.
- ✓ Find new ways to restore and maintain the health and productivity of disturbed ecosystems.
- ✓ Define the role of vegetation management and prescribed fire in restoring ecosystems.
- ✓ Determine the effects of public policy and law on forest and grassland ecosystems.
- ✓ Study the effects of insects and pathogens on fuel dynamics and flammability.
- ✓ Evaluate the influence of human activities, exotic species, and ecological restoration efforts on fish and wildlife habitats and populations.

LOSS OF OPEN SPACE

Current Emphasis

- ✓ Documenting the extent and distribution of private rangeland owned by ranchers having federal grazing permits.
- ✓ Surveying social values, attitudes, and beliefs of ranchette owners.
- ✓ Evaluating the role of isolation of fish populations on the increased risk of extinction to help prioritize restoration associated with fire and fuels management.
- ✓ Modeling the effects of fragmentation and developing conservation standards for genetic variation in bull trout.
- ✓ Evaluating threats associated with fragmentation and isolation of Lahontan cutthroat trout.
- ✓ Predicting stream temperatures and how they are affected by management, climate change, and large fires in fragmented aquatic habitats across entire river basins.
- ✓ Highlighting habitats fragmented by road culverts to help prioritize culvert upgrade and removal.
- ✓ Studying effects of management practices on the population viability of the northern goshawk, a FS sensitive species.
- ✓ Estimating water flows in ungauged watersheds and designing road crossings that are passable to fish.

Research Results

- ✓ Ecological response occurs because of both habitat fragmentation and loss in overall habitat; habitat fragmentation and loss in overall habitat usually occur together.
- ✓ Fragmentation has made many native aquatic species more vulnerable due to loss of genetic variation and mixing between populations, limited resilience to disturbance, and obstacles to migration.
- ✓ The threat of local extinction for species such as bull trout increases exponentially with the decline in remaining habitat patch sizes.
- ✓ Fragmentation can be caused or exacerbated by road culverts, climate change, and the invasion of exotic species. Some of these factors can be modified through management and rehabilitation efforts.
- ✓ The thresholds for sudden shifts in ecological responses to fragmentation vary depending on the ecological response being examined. Species with good dispersal are not sensitive to fragmentation while poor dispersers are very sensitive to fragmentation.

- ✓ Isolated populations of fishes are more vulnerable to local extinction precipitated by natural and human caused disturbances such as large fires.
- ✓ Trends in human development and their effects on biological processes are found in a book, titled "Stewardship Across the Boundaries".

Future Research

- ✓ Determine the thresholds for fragmentation for species with different dispersal capabilities.
- ✓ Assess the effects of habitat fragmentation in biodiversity.
- ✓ Evaluate the influence of large-scale disturbances, such as fires, on population connectivity and recolonization.
- ✓ Develop guidelines for managing landscapes in order to maintain a mosaic of habitats and species diversity in fire-prone ecosystems.
- ✓ Link stream temperature models with hydrologic models to predict the effects of stream-channel disturbances associated with wildfire, storms, and management activities.
- ✓ Assess the contribution of land ownership patterns, such as parcelization, to fragmentation.

UNMANAGED RECREATION

Current Emphasis

- ✓ Evaluating effects of off highway vehicle noise on Northern Spotted Owl.
- ✓ Developing methods to restore native vegetation on unwanted roads and campsites.
- ✓ Helping managers predict erosion and sediment delivery from OHV trails.
- ✓ Developing road network and OHV trail inventory systems to estimate the effects of roads and trails on watershed resources.

Research Results

- ✓ Response of Mexican Spotted Owl to noise from low flying aircraft was no worse than response behaviors to natural events.
- ✓ Restoration of areas damaged by OHV using ripping and the addition of organic materials and nutrients (such as sawmill waste) can help recover soil productivity.
- ✓ Restoration of areas damaged by recreation use can be accomplished by eliminating unwanted trails and campsites, with a focus on wilderness and protected areas.

Further Research

- ✓ Identify the attitudes and values of OHV users that define a quality recreation experience.
- ✓ Delineate the social conflicts brought about by recreation uses such as hiking, bike riding, horseback riding, backcountry skiing, and OHV use (including snowmobiling).
- ✓ Develop new types of information, education, and social activities that can be used in different situations to promote responsible use of OHV.
- ✓ Determine the effects of socio-demographic changes in communities adjacent to public lands on landscape values, uses, and conflicts.
- ✓ Establish local economic consequences of changing access to OHV on public lands.
- ✓ Document the extent and severity of vehicle emissions from OHV's on local air quality, the spread of spread invasive species, noise disturbance on species and habitat, and the degradation of water quality.
- ✓ Quantify the physical, ecological, and social impacts of different recreation uses associated with or affected by OHV recreation.
- ✓ Extend riparian restoration techniques to areas damaged by OHV to rehabilitate compaction, erosion, and damage to stream banks.
- ✓ Gain a better understanding of hydraulic conductivity of OHV trails and its erosion potential.
- ✓ Develop scientific bases underlying policies for designating trails for OHV use, limiting unauthorized use, and monitoring and enforcement compliance.
- ✓ Provide a quality experience to OHV users while reducing resource damage by improving the design of OHV recreation.
- ✓ Develop effective erosion and runoff mitigation techniques that do not interfere with the recreational experience.